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THE FIELD STUDY NOTEBOOK FOR THE OUTDOOR SCHOOL.

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THE "FIELD STUDY NOTEBOOK" HAS BEEN PREPARED FOR USE BY PAROCHIAL AND PUBLIC ELEMENTARY SCHOOL STUDENTS FOR STUDYING ECOLOGY AT AN OUTDOOR SCHOOL. THE NOTEBOOK EMPHASIZES COMMUNITY DYNAMICS THROUGH STUDENT ACTIVITIES THAT ILLUSTRATE ECOLOGICAL RELATIONSHIPS. INFORMATION IS PROVIDED ON THE ORGANIZATION OF A FIELD STUDY AND ON PERFORMING VARIOUS ACTIVITIES. SPACE IS PROVIDED FOR THE STUDENT TO RECORD HIS OBSERVATIONS AND ACTIVITIES. THE FOUR MAJOR SECTIONS OF THE NOTEBOOK DEAL WITH THE STUDY OF (1) SOIL, (2) PLANTS, (3) AQUATIC HABITATS, AND (4) TERRESTRIAL VERTEBRATES AND INVERTEBRATE ORGANISMS. SOME OF THE ACTIVITIES ARE (1) PH DETERMINATION, (2) TEMPERATURE DETERMINATION, (3) DETERMINATION OF SPECIES COMPOSITION AND STRATIFICATION, (4) DETERMINATION OF PRESENT AND PAST INFLUENCES ON THE COMMUNITIES, (5) DETERMINATION OF HEIGHT, DIAMETER, AND AGE OF TREES, (6) THE STUDY OF A ROTTING LOG, (7) SLOPE MEASUREMENT, AND (8) DETERMINATION OF STREAM FLOW. QUESTIONS RELATIVE TO THE STUDENT'S OBSERVATIONS ARE DISTRIBUTED THROUGHOUT THE NOTEBOOK. A GLOSSARY IS PROVIDED FOR EACH SECTION. A BRIEF PICTORIAL GUIDE IS AVAILABLE FOR ASSISTANCE IN IDENTIFYING COMMON AQUATIC INVERTEBRATE ORGANISMS. OTHER RESOURCES "THE TEACHERS' HANDBOOK," "THE COUNSELOR'S HANDBOOK," AND "THE STUDENT GUIDEBOOK" ARE ALSO AVAILABLE FOR THE OUTDOOR SCHOOL UNDER SEPARATE COVER. (DS)

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THE FIELD STUDY NOTEBOOK

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FOR THE

OUTDOOR SCHOOL

SE004 370

THE FIELD STUDY NOTEBOOK

FOR

OUTDOOR SCHOOL

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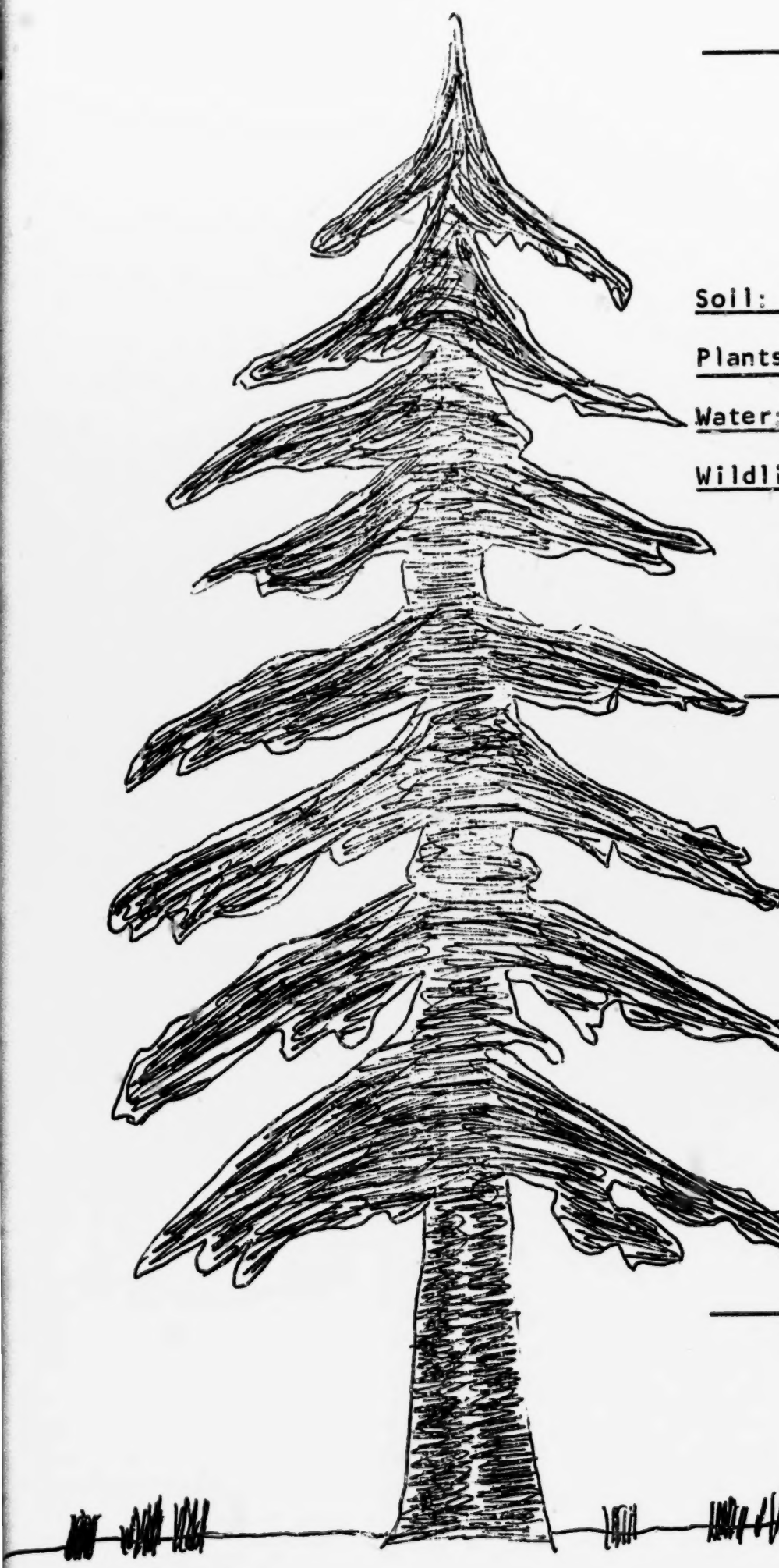
This notebook was derived from the original Field Study Notebook for the Outdoor School by Margaret Milliken, Associate Professor, Oregon State University, and Austin Hamer, formerly of the Oregon Game Commission. Valuable additions have been made by Roy Johnson and George Otte of the Soil Conservation Service, Ron Rohweder of the Oregon Game Commission, Ed Quan of the State Sanitary Authority, and Ernie McDonald of the U.S. Forest Service. Full acknowledgement is given for the material created by the original authors and it is printed with their permission for use in conducting pilot projects in outdoor education. Much of the material herein has been prepared expressly by the staff for the Regional Outdoor Education program as operated in the Portland, Oregon Metropolitan area under a Public Law 89-10 Title III project.



THIS NOTEBOOK BELONGS TO:

_____

THE NAME OF MY RESOURCE COORDINATOR IS:

Soil: _____

Plants: _____

Water: _____

Wildlife: _____

THE NUMBER OF MY FIELD STUDY PLOT IS:

_____

MY ATTENDANCE BOARD NUMBER IS:

_____

THE DATES OF MY FIELD STUDY OBSERVATIONS WERE:

_____ to _____

INTRODUCTION

This notebook has been prepared for the student who wishes to learn about the soil, water, plants, and animals that live together in a community. In your study of natural resources, it is intended that you will use the methods of the naturalist, scientist, and the outdoorsman in gathering factual information.

Since you will want to write down what you see and do, space has been provided in this notebook. You will find a place to record everything you discover above, on, and below the surface of the soil. Also, you will find information to tell you how to do and make many things. By doing the suggested activities in your field study, you will better understand the significance of America's indispensable resources, and what is expected of you for continued enjoyment of them.

You are encouraged in your field study to discuss what you observe with your teacher, counselors, and Resource Coordinators. This will help you to avoid errors and your observations will be more accurate.

We want you to enjoy your field study in the outdoor laboratory. We hope you will learn through this study that each form of life, including Man, strives for the survival and reproduction of its kind. In this struggle for existance, there is conflict. Man, through his wise use of natural resources, is attempting to achieve a state of harmony between himself and his environment. The result of your study should help to prepare you to accept the responsibilities of today's citizen, and enjoy the pleasures of this most wonderful world.

ORGANIZATION OF THE FIELD STUDY

Before you begin your field study there are some things that you need to know and understand. The following information will help you in learning about your instructional periods in Mother Nature's classroom. By reading this information carefully, you should know what to expect, and what is expected of you.

Field Study Plots

In your field work you will have the opportunity to study the science of Ecology, or how plants and animals relate to their environment and to each other. The area where you will study is called an ecological study plot. This is a piece of land which will vary in shape but will probably involve one or more acres. The area should include a wooded area, open area, a stream or pond, several kinds of soil, and a variety of plants and animals. This is so you can study different plant and animal communities and can see how different conditions such as climate, exposure, and moisture affect them. In your study you will learn that plants and animals sometimes have problems in getting along together, much the same as human families do. This is because some of them live in poor soil, have very little water to use, or their habitat has been disturbed by the elements or by Man. However, through your exploration and activities you will discover there are solutions to the problems plants and animals have living together in a community, and what Man can do to help them.

Field Study Groups

Your class will be assigned to a field study area. Your class group will have several experienced leaders to help with your field study.

Field Study Rules

Because you will be exploring Nature's treasures, it is necessary that we have some rules. These rules are for your protection, and so that others

in years to come can also find a green and beautiful field study area to investigate, instead of a bare and ugly misused one.

1. Remember to turn over your attendance board number tag upon entering and leaving the field study area.
2. Never wander off by yourself; always stay with another person.
3. Obtain permission from your teacher before leaving the field study plot.
4. Always carry and use tools correctly to avoid injury.
5. Treat the property with respect, leaving no undesirable evidence of your use.
6. Leave your field study area cleaner than you found it.
7. Walk, don't run.
8. Keep on the trails to avoid trampling of plants, and to minimize erosion.
9. Avoid disturbing the plant cover on steep slopes.
10. Avoid marking of living trees and shrubs.
11. Never remove a plant or take a collection specimen unless you can leave several untouched near by.
12. Avoid disturbing or killing small animals such as insects, frogs, chipmunks, and snakes.
13. Never take from your field study the small animals you live-trap for study.
14. Keep close watch at all times for roots on the trails and for overhanging branches.
15. Avoid letting overhanging branches snap back and hit the person behind you.
16. Be sure to return all supplies and equipment to the field study box after use.

Instructional Periods

Each day you and your classmates will participate in field study sessions. Accompanied by your teacher, counselors, and field study leader, you will have the opportunity to explore a natural environment together.

Many kinds of interesting learning activities such as collecting and preserving plant and animal specimens; live-trapping of small animals for

study; and measuring the age, height, and diameter of trees will be provided during this time. The leaders will help to acquaint you with the activities possible during your field study explorations.

Always remember to take your Field Study Notebook with you for you will need it to record the interesting things you learn. Also be sure you are dressed appropriately. It is your responsibility to wear rain boots or water-resistant boots if you are scheduled for water study. Upon completion of the field study, you will have time to describe and show to others the things you have learned during your study of the natural environment. This evaluation period will enable you to see and discuss differences and similarities of all the study areas. Also, the specimen collections and other project work can be demonstrated and compared for different techniques used. It is hoped that this type of evaluation session will help you to have a better understanding of Nature's growing things.

ECOLOGY

The land is a dynamic, living, ever-changing community of plants and animals dependent upon each other and the other resources for survival. The land does not stand still. Plants and animals are born, grow, and die, to enrich and change the soil.

Organic material, thus added, affects the ability of the soil to absorb and hold water that is needed by plants and animals. As the structure of the soil is changed by decomposing plants and animals, new types of plants are able to grow. This, in turn, determines the kind and the number of animals that can live in an area.

The relationship of Man to the land has undergone many evident and complex changes. Man has used and converted the natural resources of the land to benefit his life. He has done things that have been bad for the land and bad for himself. Fortunately he has also done other things which have been good for the land and himself.

If Man is to survive on earth he must learn to live in harmony with the natural resources because he is totally dependent upon them. Past civilizations flourished when they had plenty of natural resources but vanished when the supply of resources dwindled.

This study of the affect of the natural resources upon one another and also how Man influences and is influenced by the resources is called "Ecology." This term comes to us from two Greek words that mean "the study of the home."

The first step in learning how to live with our resources is to understand some of the ways that each natural resource affects the other resources. The following chart shows some of the ways that resources affect each other.

HOW RESOURCES AFFECT EACH OTHER

SOIL	**Water**	**Plants**	**Wildlife**	**Man**
	Affects: Runoff Percolation into ground Underground storage Purity by filtration	Anchor plants. Supplies water & Minerals. Affects where plants grow by: Topography, elevation, soil depth, acid or alkalinity of soil.	Affects where animals live because of topography, elevation, availability of water and types of plants which grow.	Affects: Productivity of soil. Where man lives. What he produces. Economy based on location of resources. Scenic values.
WATER	**Soil**	**Plants**	**Wildlife**	**Man**
	Washes away soil Affects types of soil (swamp, desert). Helps break down soil by freezing, flowing, and seepage.	Affects: Transpiration Where plants grow -- swamp, hillside, rainfall, fog, snow, etc.	Affects: Aquatic animals Where animals live by their need for water and food.	Provides scenic values, recreation. Affects where man lives (floods, drought), what he grows on soil.
PLANTS	**Soil**	**Water**	**Wildlife**	**Man**
	Help rocks break into soil by root penetration. Make organic fertilizer which enriches soils and absorbs water. Hold soil in place. Protect soil from rainfall.	Make open spaces in soil for water penetration, tap roots. Shade streams, keep water cool. Use water in transpiration. Purify water.	Provide food, shelter; water in succulent plants for drinking. Give off O_2 for breathing.	Provide: Forage for cattle Shelter Necessities & luxuries of life Recreation Shade Scenic values
WILDLIFE	**Soil**	**Water**	**Plants**	**Man**
	Make organic fertilizer. Cause soil compaction. Build beaver dams -- percolate & hold H_2O in soil prevent soil erosion	Pollute water. Build beaver dams -- flood control, water storage.	Fertilize plants. Carry seeds. Give off CO_2 that plants need. Destroy plants	Provide scenic values, recreation, hunting, fishing, livelihood in trapping. Damage crops. Kill livestock.
MAN	**Soil**	**Water**	**Plants**	**Wildlife**
	Increases & decreases soil productivity. Causes soil erosion. Puts new lands in production. Changes face of the earth. Manages for his benefit.	Stores water in dams Pollutes water. Diverts water. Uses more water than available in some areas. Manages for his benefit	Grows new crops Eliminates natural plants. Clears land of plants. Harvests trees & grass. Manages plants for his benefit.	Harvests wildlife and natural predators. Upsets nature's cycle of animals. Manages for his benefit.

A STUDY OF SOIL

General Information

The story of soil formation begins with solid rock. Through the ages, solid rock has been broken into smaller pieces by many kinds of processes. The freezing and thawing of water; pressure of growing roots; moving ice, water, and wind; and chemical reactions with the rock minerals all help to break up the rocks. These and other processes have formed the few inches of topsoil which support life.

The darker topsoil is built up gradually from the subsoil below it by the addition of humus from decaying plants and animals. The subsoil layer is usually lighter colored and contains less decayed plant material. It is usually more compact and clayey, and light, air, and water may not penetrate it as rapidly. Therefore, subsoils are not as favorable to the growth of plants as is the topsoil. Between the lowest subsoil and the solid rock is a layer of parent material that is mostly raw rock fragments and minerals that are poor for plant use.

As you look around the field study area, you may find soils that have different colors, some with more sand or clay than others, some with stones on the surface, etc. These differences can be caused by a variation in the kind of rocks and plants that have formed the soils. Topography, temperature, rainfall, and the age of the soil may also make it different from other soils.

If you dig below the surface of the ground in several places, you may be able to see how earthworms and other small animals help to grind up materials into finer particles as they eat their way through the soil. Of course, you will want to record the animals or signs of them that you find.

Things to look for in a soil:

1. Color - tells about organic matter, drainage, biotic activity, fertility.
2. Texture - the feel -- sandy, loamy, clayey -- tells water-holding capacity, tilth workability.
3. Structure - the shape -- blocky, platy, granular -- tells drainage, permeability, aeration, water intake.

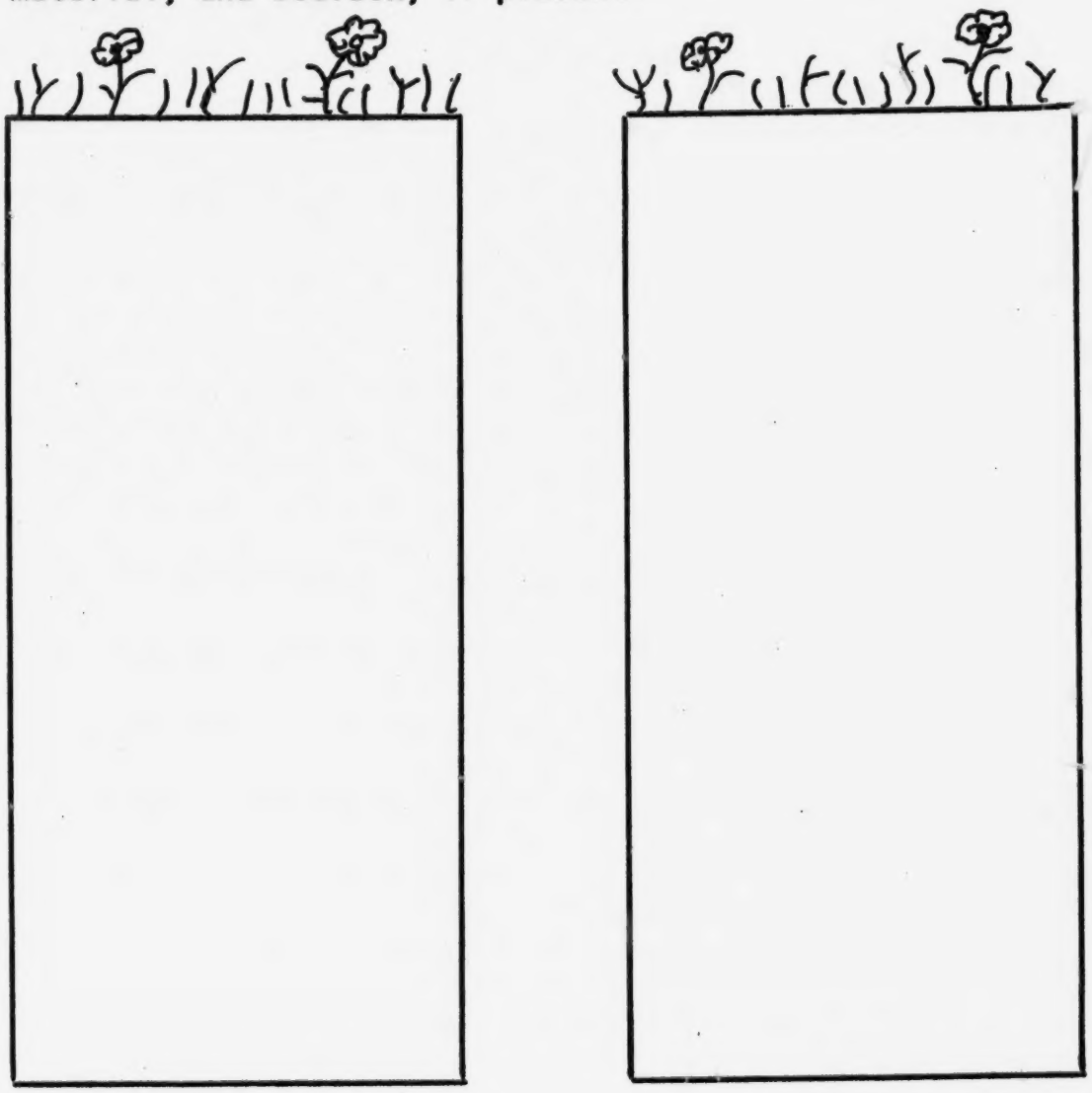
4. Depth - the size of the storage bin -- moisture, plant foods.

5. Reaction pH - the suitability of plants and soil, general fertility level.

Field Study Recordings

1. Examine the soil profile on your study plot by locating an exposed, vertical section through the soil, or by digging a hole with a spade. Record your observations on the No. 1 profile. If it is possible, locate another soil under different vegetation or on a different slope and complete profile No. 2.

   a. Show the thickness of the duff layer, topsoil, subsoil, parent material, and bedrock, if present.



No. 1 No. 2

Diagram and label. Color for each layer should be as described in the color chart.

b. Record

(1) Color

1. Black or dull gray
2. Dark brown or reddish brown
3. Light brown or yellow
4. Light gray
5. Dull gray or mottled

(2) Depth & thickness of soil - 0-6", 6-14", 14-20", etc.

(3)

Texture	Water Holding Capacity	Looseness
Sand - Gritty	Poor	Good
Silt - Smooth, Flourlike	Good	Good
Clay - Sticky & Plastic	Good	Poor

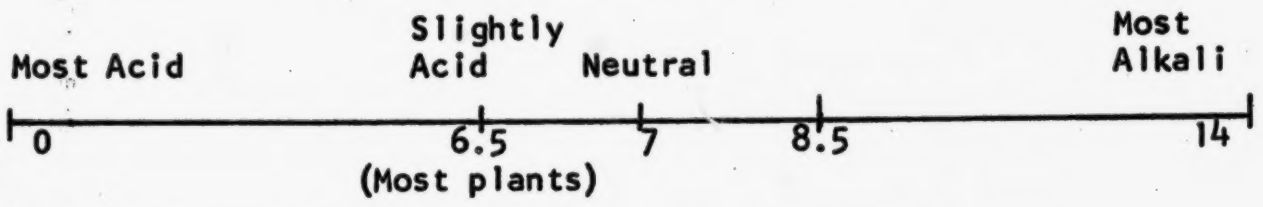
(4)

Structure	Drainage
Granular - particles small rounded	Good
Blocky - Various sizes, uneven sided	Good
Columnar - Particles longer than wide	Good
Platy - Like leaves in a book	Moderate

SOIL #1	SOIL CHARACTERISTICS			
Layer	Color	Depth	Texture	Structure
Duff				
Topsoil				
Subsoil				
Parent Material				
Bedrock				

SOIL #2	SOIL CHARACTERISTICS			
Layer	Color	Depth	Texture	Structure
Duff				
Topsoil				
Subsoil				
Parent Material				
Bedrock				

c. Record the pH of the soil. This is a chemical test that will help tell you how easy it is for plants to get their plant food elements - nitrogen, phosphorus, potash, sulfur, etc., from the soil. The measured pH is a number that will fit on the pH scale. This scale is numbered from 0 - 14.



Let's use some common items to demonstrate this. Some examples are: soap - pH 9, sea water - pH 8, pure water - pH 7, sour milk - pH 5, orange juice - pH 4, lemon juice - pH 3, etc. Only a few plants can get enough of the nutrients from the soil when the pH is more acid than 4.5 or more alkaline than 8.5. Most plants prefer a pH of 6.5 (slightly acid). It is at this pH that plants seem to best take plant food elements from the soil into their roots and use.

Instructions for using pH chemicals. Place a particle of soil about the size of your little fingernail on a spot plate or porcelain dish. Moisten the soil with the special color indicator. After it has reacted with the soil, match the color of the soil with the color chart and record the pH on the chart below.

	pH Number of				Type of plants that grow best in this soil
	Duff	Topsoil	Subsoil	Parent Material	
Soil #1					
Soil #2					

d. Temperature. Plants do not like to grow when soils are too cold or hot. Most plants do not grow when soils are colder than 40° F., and soil bacteria and fungi will not be very active. Most plants grow best when soils are 65° to 70° F., and slow down their growth at 85° to 90° F. Check the air and soil temperatures of each soil examined and record on the table.

Soil #1

Record of Microclimate Readings	Temperature
Air temperature 3 feet above soil surface	
Air temperature just above soil surface	
Soil temperature of topsoil	
Soil temperature of subsoil	
Soil temperature of parent material	

Soil #2

Record of Microclimate Readings	Temperature
Air temperature 3 feet above soil surface	
Air temperature just above soil surface	
Soil temperature of topsoil	
Soil temperature of subsoil	
Soil temperature of parent material	

2. List the plants and animals that you can find on the surface and within the top 4" of soil in your field study area. (Spiders, worms, ants, snails, fungus, molds, etc.)

Plants (Name)	Dead or Alive	Animals (Name)	Dead or Alive

3. Measure the slope of your field study area to determine the best use of the land. Record findings.

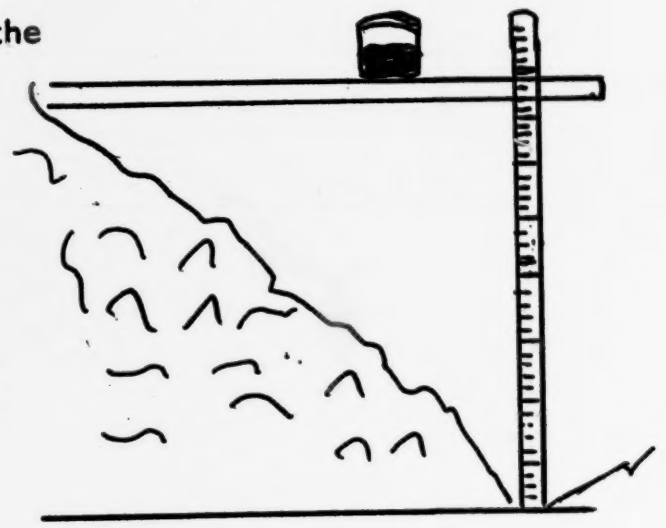
Instructions:

a. Select where you plan to measure the slope and place a 50-inch stick horizontally on the ground.

b. Place a flat pan half full of liquid on the 50-inch stick and raise or lower the free end until the water shows that it is level.

c. Using a yardstick, measure the distance to the raised end of the stick above the ground.

d. Read this distance in inches and multiply by 2 to determine the percent of slope.



25" X 2 = 50% Slope

Record of observation:

a. Distance from ground to level stake = _____ inches.

b. _____ inches X 2 = _____ percent of slope.
(Distance in inches)

c. Chart to determine slope of land.

% Slope	Degree of Slope	Use of Land
0% - 6%	Level to gently sloping	O.K. to farm
6% - 18%	Gently to strongly sloping	Difficult to farm
18% - 25%	Steep	Pasture, Woodland, Recreation
25% - & over	Very Steep	No farming, use for recreation, forestry wildlife

Degree of slope of study area =_____

4. Determine the kinds and amount of erosion present in the field study area.
Sheet erosion is the removal of soil without easy to see channels.
Rill erosion leaves many small easy to see channels.
Gully erosion leaves ditches that may be too deep and wide for machinery to cross.
Bank erosion is caused by streams washing soils from stream banks.
Splash erosion is caused by raindrops hitting bare soil.

Record information on chart.

Kind of Erosion	Evidence	Amount of Soil Lost (Great or Small)
Sheet		
Rill		
Gully		
Bank		
Splash		

5. Record these observations.

Does your soil have good drainage?_____

How can you tell?_____

What difference in temperature did you record in the shaded area as compared to the open areas?_____

_____

What differences in vegetation is there?_____

_____Why?_____

How does organic matter affect the water holding capacity of the soil?

_____

From observations you have made what do you think would be the best use of these soils?_____

_____

What is the best use of the land where your field study area is?_____

_____

How do animals living in the soil affect the soil?_____

_____

What affect does soil have on the other resources in your study area?

Plants_____

Water_____

Wildlife_____

Instructions for Making a Micromonolith

Equipment:

1. Blotting paper (optional)
2. Cardboard (4 x 7¼" - printed)
3. Knife
4. Clear waterproof cement
5. Plastic spray
6. Metal soil cutter

Procedures: (Soil condition may require using alternate procedures)

Wet Conditions

1. Place wood block in cutter.
2. Place small blotter in cutter over wooden block.
3. Cover blotter with waterproof cement.
4. Push cutter into soil.
5. Push knife into soil back of cutter - pry out.
6. Trim loose and excess soil away from top of cutter.
7. Push wood block upward until soil sample is above top of cutter.
8. Cover area on card where soil sample is to be placed with waterproof cement.
9. Lift or slide soil sample from cutter to card and press lightly into cement. (Step 8)
10. Repeat for each soil layer in soil profile.
11. Clean smears, etc., off of card as best you can.
12. Let micromonolith dry somewhat as necessary.
13. Record required information on card <u>in pencil</u> - (ink will run).
14. Spray the face of the micromonolith with plastic spray.

Normal Conditions

1. Place wood block in cutter, (if block is not moist - moisten same.)
2. Take about two level tablespoons of soil from one layer of the soil profile.
3. Place the above soil in the palm of one hand.
4. Work the soil with the fingers of other hand to form it into a ball. If too dry add a drop of water at a time until a ball is formed - don't add <u>any more</u> moisture than is necessary - it's a sticky, muddy mess if too much water is used.
5. Press the ball of soil in the cutter over the wood on block. (Press into all corners and sides firmly.)
6. Remove excess soil above level of cutter top. (Use knife or straight edge.)
7. Cover area (block) on card where soil sample is to be placed with waterproof cement.
8. Push wooden block upward into cutter until soil sample is above top of cutter.
9. Lift or slide soil sample from wooden block to cement area on card (Step 7). Press on slightly.
10. Clean card of smears as best you can and let dry somewhat.
11. Repeat for each layer of soil in the soil profile.
12. Record information on card <u>in pencil</u> - (ink will run).
13. Spray face of micromonolith with plastic spray.

MICROMONOLITH CARD

SOIL PROFILE

STUDENT NUMBER

DUFF

COLOR

DEPTH

pH

STRUCTURE

TEXTURE

TOPSOIL

COLOR

DEPTH

pH

STRUCTURE

TEXTURE

SUBSOIL

COLOR

DEPTH

pH

STRUCTURE

TEXTURE

PARENT MATERIAL

COLOR

DEPTH

pH

STRUCTURE

TEXTURE

GLOSSARY
A List of Soil Words

Accelerated Erosion - Man's misuse of land speeds up nature's process and results in excessive soil loss.

Fertile - Applied to soils this means soil which contains all things essential for good plant growth.

Geologic Erosion - The never ending slow process of nature in making soils and moving them about.

Humus - Decayed organic matter that forms the dark colored top layers of soil.

Infiltration Rate - The rate at which soil will take water.

Inorganic - Mineral, inert or non-life type of matter

Legumes - Broad leaved vegetation which takes nitrogen from the air and stores it in its root system.

Micromonolith - A card with samples of the different layers or a layer of the soil profile glued on it..

Organic - Matter which has been related to life or life processes which is subject to decay by bacteria.

pH - The number designation of the amount of acid or alkaline in the soils.

Reservoir - A place where water is collected and stored for use. Usually related to a man-made structure, such as a reservoir behind a dam.

Soil - Decayed rock or parent material and usually mixed with organic matter.

Soil Profile - A cross section showing the "layers" of soil -- usually the topsoil, subsoil, and parent material

Structure - The shape of the soil, blocky, platy, granular, columar. It affects the drainage and air and water intake of the soil.

Tap Roots - Roots which penetrate the soil downward rather than laterally.

Texture - The feel -- sandy, loamy, clayey -- affects the water holding capacity and workability of the soil.

Watershed - A natural basin or area where water is naturally stored for later distribution through a river or stream or ground-water system. Any area of land which drains into a particular stream or other body of water.

Water Table - The height at which free water occurs in the soil profile.

A STUDY OF PLANTS

General Information

In your study of plants you will explore the field study area to determine what types of plants are living there. You should find trees, grasses, grass-like plants, ferns, mosses, lichens, shrubs, flowering plants, and aquatic plants. Also, you will soon discover that certain plants are usually found associating together, just as you have certain best friends. Do you know why they occur together? To find the answer to this question you will want to know something about the factors that are responsible for plants living together in a community, such as types of soil present, drainage conditions, moisture conditions throughout the year. temperature condition, type of exposure, life zone distribution and elevation.

Since you are interested in collecting and preserving some of the plants you discover, you will have the opportunity to do so. Your field study leaders will tell you what should be picked and what should not be picked, because some plants do not readily reseed or reproduce themselves. Of course, you would not want to destroy any of the plants living in your natural community.

It is hoped from your study of plants you will find answers to such questions as: What are the characteristics of plants? How are they classified? What is their importance to Man and other animals? How can we use them wisely so they will be here forever?

Field Study Recordings:

1. Plants grow at different levels in the plant community. You will find trees, shrubs and bushes, flowering plants, ferns, mosses, grasses, lichens, fungus, molds, etc. Collect, identify, and classify several specimens of plants from the upper level (1) middle level (2), and lower level (3) of the plant community on your plot.

LICHENS (____Level)

Species	Abundance	Importance	Shade Tolerance		
			Open Sunlight	Partly Shade	Dense Shade

FUNGI (____Level)

Species	Abundance	Host Plant or Animal	Type	Importance

MOSSES AND FERNS (____Level)

Species	Abundance	Importance	Shade Tolerance		
			Open Sunlight	Partly Shade	Dense Shade

WILD FLOWERS (____Level)

Species	Abundance	Importance	Shade Tolerance		
			Open Sunlight	Partly Shade	Dense Shade

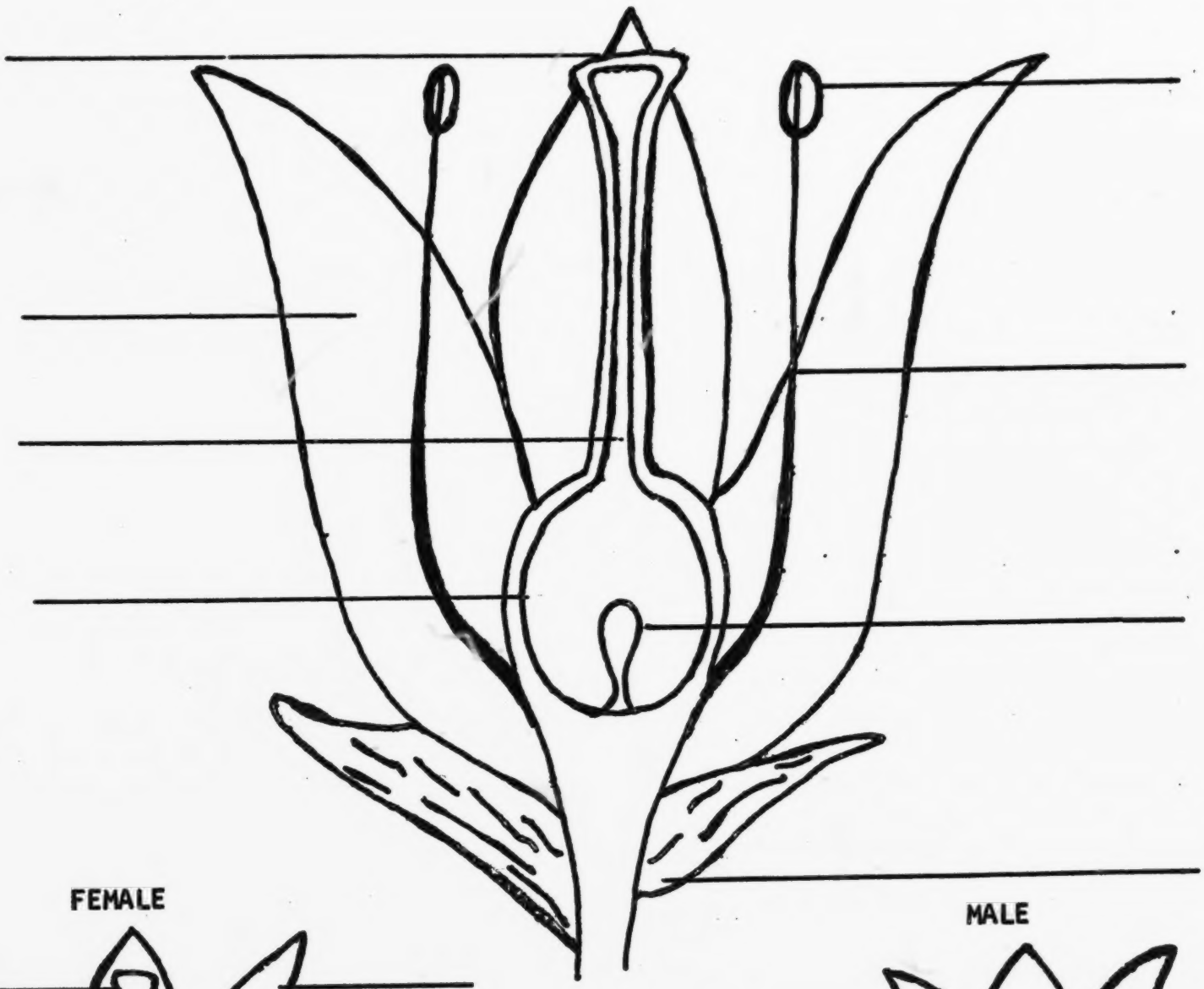
SHRUBS & BUSHES (____Level)

Species	Abundance	Importance	Shade Tolerance		
			Open Sunlight	Partly Shade	Dense Shade

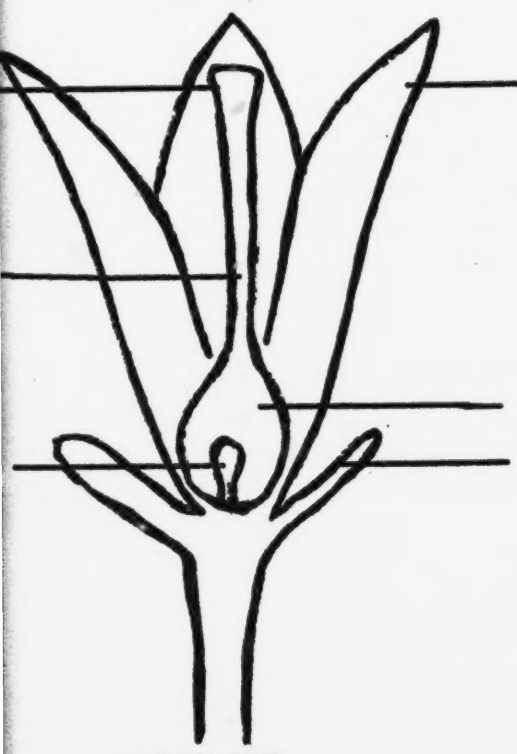
TREES (____Level)

Species	Abundance	Importance	Shade Tolerance		
			Open Sunlight	Partly Shade	Dense Shade

CROSS SECTION OF A TYPICAL FLOWER



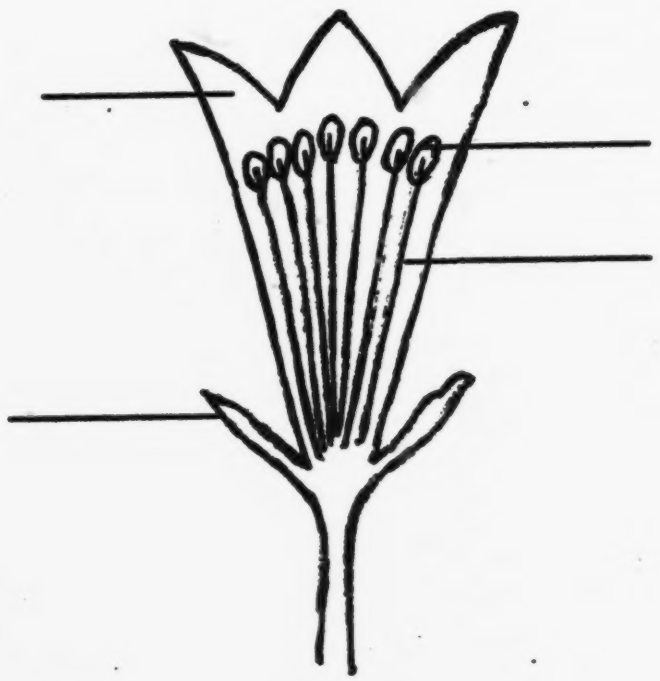
FEMALE



PISTOLATE

INCOMPLETE FLOWERS

MALE



STAMENATE

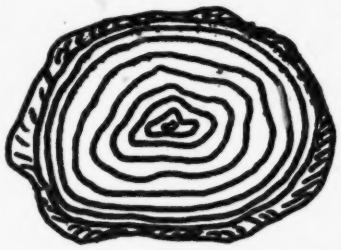
2. Look for insect damage, fire scars, evidence of disease, lightning strikes, wind damage, human vandalism, or other evidence of Man's destruction of the forest in your study area; record information on chart.

TYPE	EXTENT OF DAMAGE

3. Determine whether your field study area is reseeding naturally or by artificial methods. Do you see lots of little seedlings present? If there are none, how would you get a new forest started? Record your findings.

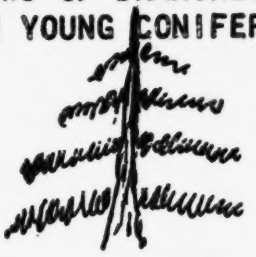
4. Ages of Trees. It is often important to tell the ages of trees to determine how old or how fast they are growing. We can count the growth rings on a stump of a cut tree and determine the age of the tree when it was cut. Many conifer trees grow a row or whorl of branches each year. We can count the whorls of branches on these trees and tell how old the tree is now. On large standing trees we can use an increment borer to bore into the tree and remove a small core and count the rings to determine the age. Many times we can reconstruct past events that have taken place on our plot by collecting and recording the age of trees.

RINGS ON STUMP



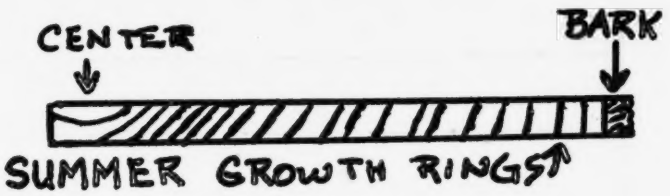
____Rings + 5 Yrs = ____
Age

ROWS OF BRANCHES ON YOUNG CONIFERS



___Whorls of branches + 5 yrs. =_____
Age

RINGS ON CORE TAKEN FROM TREE



____rings + 5 Yrs. = _____
Age

(Note:) It takes about 5 years for a tree to become large enough to grow a ring of wood or add a row of branches a year. Count the whorls then add 5 years to each of your answers for total age.

Many times we can reconstruct past events that have taken place on our plot by collecting and recording the age of trees. Collect and record the following data:

Tree Stump: Age_____, Probable Species_____

Age_____, Probable Species_____

What were the trees used for_____

Standing Trees: (Count rows of branches on young trees or use increment borer on larger trees)

Age_____,Species_____

Age_____,Species_____

Age_____,Species_____

Were the standing trees here before or after the trees were cut from the stumps?_____. How can you tell?_____

If they were here before, why weren't they cut too?_____

_____

If they started growing after the other trees were cut, does their age help us determine how long ago the trees were cut?_____

_____

Why?_____

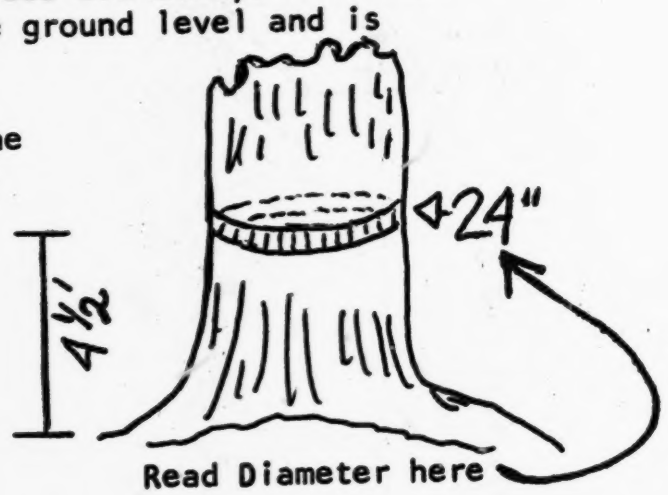
How long ago were the trees cut from the stump?_____

5. Diameter of a tree

Measuring the Diameter of Trees. One important tree measurement a forester needs is the diameter of the tree at 4½ feet above the ground. The diameter helps him determine the wood volume of a tree. The diameter and the increment core together helps him determine if the tree is growing fast or is ready for harvest.

The Diameter Tape is the measuring tape that tells the diameter of a tree by measuring the circumference of the tree. The forester must know the diameter and height of the tree to determine how much lumber it contains. Diameters of trees are always measured at "D.B.H." This is always 4½ feet above ground level and is called diameter breast high or d.b.h.

To use: Wrap the diameter tape around the tree at d.b.h. The diameter of the tree will be the inch mark nearest where the tape overlaps the zero end of the tape.



If you don't have a diameter tape, use a regular measuring tape and get the circumference of the tree and then divide by 3.14 inches to obtain the diameter. Remember the diameter is approximately 1/3 the circumference.

6. Height of a tree

You will want to measure the merchantable height of the tree. The merchantable height is the part of the tree that can be made into lumber. This is usually the place where as you look up the mainstem it narrows down to 8" in diameter.

Measure the merchantable height of the tree by following these instructions.

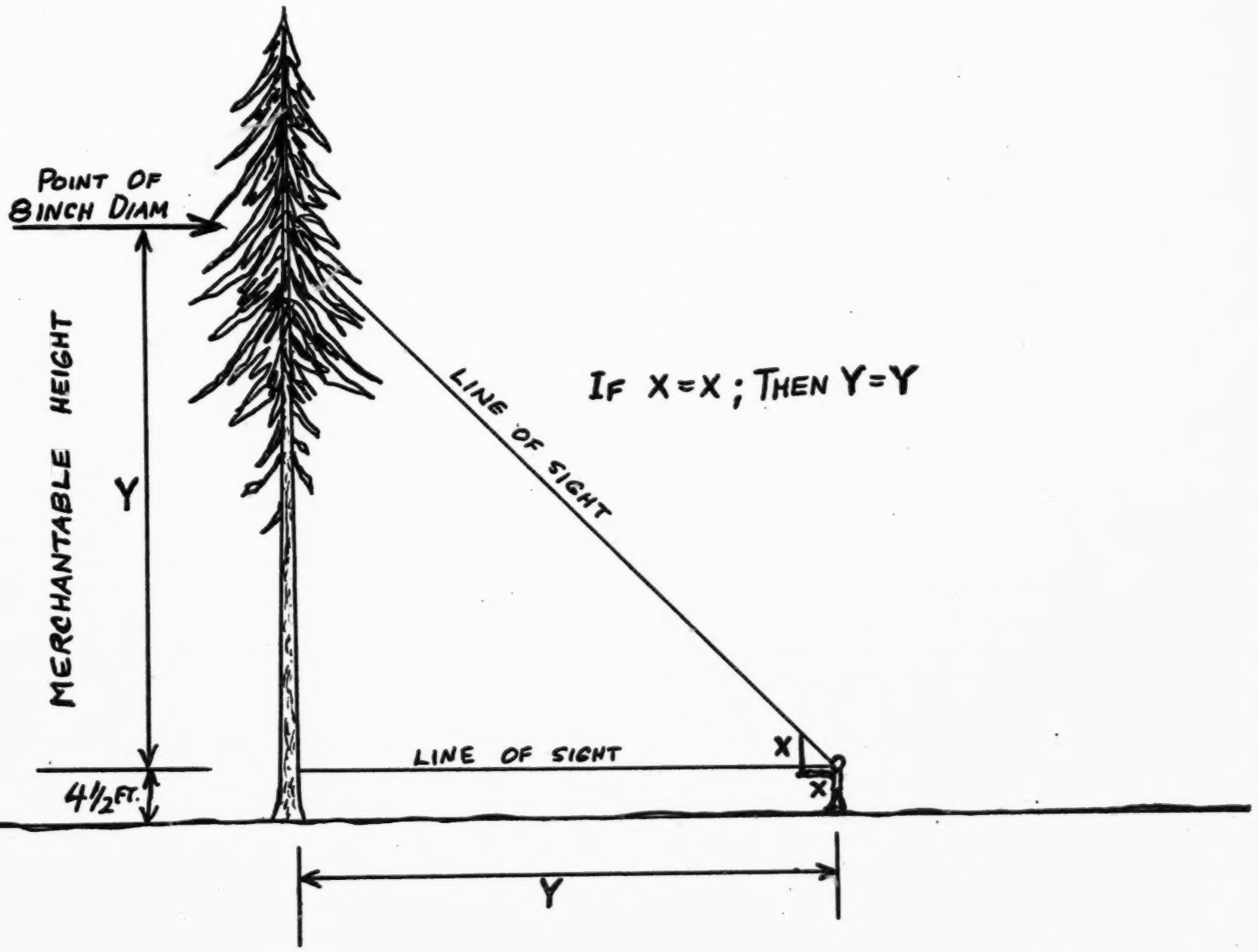
(1) Choose a stick the same length as from your hand to your eye if you hold your arm out straight in front of you.

(2) Now hold stick upright to form a right angle. (Arm and stick are same length.)

(3) Walk backward away from the tree on level ground, sighting across the upper end of the stick you are holding upright and the bottom of the stick above your fist.

(4) Continue to walk backward until the top of the stick you are sighting over is at the spot on the tree you want to measure (8" diameter) and the bottom of the stick is sighting at the base of the tree (Merchantable height of the tree).

(5) You are now the same distance from the tree as the height of the tree that you want to measure. Measure the distance from you to the base of the tree by stepping off the distance or using a tape measure.



7. Estimating Board Foot Volume

With the diameter and the height of a tree found, you can estimate the number of board feet of lumber it is possible to cut from the tree. One board foot is a piece of lumber 1-inch thick, 12-inches wide, and 12-inches long. To obtain the number of board feet in a tree, use the following table.

Board Foot Volume Table

D.B.H Inches	Height of Merchantable Tree in Number of 16 ft. Logs							
	1½	2	3	4	5	6	7	8
12	62	80	133	183	235	286		
14	64	88	147	210	274	338		
16	67	96	163	242	320	399		
18	71	109	190	280	370	459	550	701
20	75	123	221	330	435	543	651	758
22			258	383	509	633	760	884
24				438	584	728	882	1035
26					666	832	1013	1190
28					750	941	1114	1346
30					850	1062	1291	1518
32						1195	1449	1700
34						1333	1614	1898
36						1494	1782	2095
38							1955	2305
40							2150	2523

To use: Find the tree diameter in the left-hand column labeled D.B.H. (Diameter breast height) inches of the tree you measured. Find the column across the top with the number of 16' logs in the tree you measured. Read the number on the table where the lines from the diameter figure intersects the log column figure. This is the number of board feet in your tree. For example, if your tree was 26 inches in diameter and had 5 logs in it, it would have 666 board feet in it.

a. Number of 16-foot sawlogs in your tree are_____.

Trees are cut into sawlogs in order to haul them to the sawmill. We want to find out how many 16-foot sawlogs there are in this tree.

Merchantable Height _____ ft. ÷ 16 ft. = _____ sawlogs.

b. Board foot volume in your tree is _____board feet.

c. Is your tree more valuable to be cut into lumber or to be left where it is for us to enjoy?_____

_____.

d. Where might it be more valuable for lumber?_____

_____.

Species	Diameter	Age	Remarks
WRC	13	55	
	9	48	
WRC	6	36	
WRC			
WRC	16	62	

STUDY OF A TREE

Use following instructions to take and record data below:

A. Tree Species _____
(Coniferous or Deciduous)

Age of Tree: Your estimate_____

Actual Age (by boring)_____

B. Tree Growth: (underline) Fast Medium Slow

1. By observation

2. By boring - No. of rings in outside inch____

Diameter: D.B.H._____

Height_____

No. of 16' logs_____

Board Ft. Volume_____

C. Tree defects: (underline)

1. Insects
2. Wind
3. Disease (conks)
4. Man
5. Fire

D. Possible products from this tree:

1._____ 4._____

2._____ 5._____

3._____ 6._____

E. Tree's neighbors (within 30' radius)

1._____ 6._____

2._____ 7._____

3._____ 8._____

4._____ 9._____

5._____ 10._____

Sketch of tree profile

STUDY OF A ROTTEN LOG

Rotten logs are an important part of a living community. They provide homes and food for animals and a place where certain plants can grow. The log eventually decays into the soil, changing its texture, color, depth, water holding abilities, and richness.

Observe and record as many things as you can about a rotton log on your study plot.

BE SURE NOT TO TEAR THE LOG APART. IF YOU LIFT UP THE BARK TO LOOK FOR LIVING THINGS, PUT THE BARK BACK IN PLACE.

Where is the stump that the rotten log came from_____?

How did the tree that the log came from probably die: (cut, rot, wind, etc.)

_____

What species of tree was it? (Look at bark, wood structure)

_____

LIVING PLANTS IN OR ON THE LOG

Name	Location on Log (Top, side, under)	Roots in Soil or on Log
WRC		
Sword Fern		
Mosses		
Evergreen Huckleberry		
lichen		

ANIMALS IN OR ON THE LOG

Name	Type of Home	Food Eaten	Enemies

8. Find out the major uses of the plants present in your field study area; record information on chart.

USES OF PLANTS

TYPES	USE	PARTS UTILIZED
Shrubs and Trees		
Flowering Plants		
Grasses and Grass-like Plants		
Others		

9. Identify invader plants present in your field study area; record types on chart

TYPE	LOCATION DESCRIPTION

10. Identify pioneer plants present in field study area; record types on chart.

TYPE	LOCATION DESCRIPTION

11. Identify climax plants present in field study area; record types on chart.

TYPE	LOCATION DESCRIPTION

Questions on Field Study

1. What affect do the plants in your field study area have on

   (a) Wildlife?_____

   _____

   (b) Water?_____

   _____

   (c) Soil?_____

   _____

   (d) Man?_____

   _____

2. In what ways has wildlife influenced the plants in your field study area?

   _____

   _____

   _____

3. What conclusions can you make as to the affect of the soil on the plant life in your field study area?

   _____

   _____

   _____

4. How has the water resource influenced the plants in your area?

   _____

   _____

   _____

5. What has Man done to change the plant life in the area?

   _____

   _____

   _____

GLOSSARY

Clearcutting - A method of harvesting certain tree species in which all trees in a delineated area are cut, such as Douglas fir & western hemlock.

Climax Plant Community - The final stage of plant succession which continues to occupy an area indefinitely, as long as climatic and soil conditions remain the same.

Conifer - A tree belonging to the order Coniferae usually evergreen with cones and needle-shaped leaves, and producing wood known commercially as "softwood." Usually a cone bearing tree.

Cones - The seed bearing body of such conifers as the pines, Douglas fir, spruces, hemlocks, etc.

Duff - Forest litter and other organic debris in various stages of decomposition, on top of mineral soil.

Foot, Board - A unit of measurement represented by a board 1 foot long, 1 foot wide and 1 inch thick. In practice the working unit is 1,000 bd. ft.

Forestry - The scientific management of forests for the continuous production of goods and services.

Hardwood - Generally, one of the botanical group of trees that have broad leaves, in contrast to the conifers; also wood produced by such trees regardless of texture.

Heartwood - The inner core of a woody stem, wholly composed of nonliving cells and usually differentiated from the outer enveloping layer (sapwood) by its darker color.

Increment or growth - Increase in diameter, basal area, height, volume, quality or value of individual trees or stands in relation to time.

Intolerance - The incapacity of a plant to develop and grow in the shade and in competition with other plants, such as Douglas fir and ponderosa pine.

Multiple Use - A concept of wildland management aimed at producing optimum amounts of available renewable natural resources from an area. One of the principles of land management used by the U.S.Forest Service in managing the National Forests.

Plant succession - The progressive development of a plant community, by replacing one plant community with another until the climax plant community is reached.

Pruning - The removal of live or dead branches from standing trees. This may be done artificially or naturally. Natural pruning is result of deficiency of light, decay, snow, ice. etc.

Reforestation - The natural or artifical restocking of an area with forest trees.

Rings, Annual - The growth layer of 1 year, as viewed on cross section of a stem, branch or root.

Sapwood - Living wood, of pale color.

Selective Cut - Removal of individual trees from a stand of timber. Harvest of individual or small groups of trees over a period of years insures maintaining an uneven age stand such as in ponderosa pine.

Slash - Branches, bark, tops, chunks, cull logs, uprooted stumps, and broken or uprooted trees left on the ground after logging.

Sustained Yield - Continuous production at a more or less uniform annual rate based on the yield of the forest.

Thinning - Cutting in an immature stand to increase its rate of growth, to foster quality growth, to improve composition, to promote sanitation, to aid in better cover and to use material that would be lost otherwise.

Tolerance - The ability of a plant to develop and grow in the shade and in competition with other plants, such as western hemlock. western red cedar and white fir.

A STUDY OF WATER

General Information

Water is our most valuable renewable resource. It is necessary for all forms of life. Man finds more uses for water than any other animal on earth. Water is needed by man for industry, irrigation, recreation, drinking, and other home uses. Water is so important to Man that many of our cities and industries have been built next to large rivers, lakes, or the ocean. Man has built large dams to store energy of flowing rivers to provide electric power and water for irrigation in dry agrucultural areas.

The freezing and thawing of water helps break rocks into smaller particles that eventually become soil. Water helps leach nutrients down into the soil so plant roots can use them. Water in the soil is used by plants to manufacture food and animals need water in order to live.

Where does all of our water come from? Most water originates from the ocean along the equatorial belt. Heat from the sun evaporates the water and the warm air carries the water vapor to high altitudes. The water vapor is then carried to the north and south of the equator by air currents -- some warm and some cool. As the water vapor becomes sufficiently cooled, it precipitates in the form of rain, hail, sleet, or snow. Some of the water soaks into the ground and the rest flows overland into streams, lakes, and into the ocean as surface runoff. This cycle, which has no beginning or ending, is known as the "water cycle."

Some rainfall sinks into the soil as gravitational water to replenish our underground water supply and is stored in underground streams, caverns, or in air spaces between soil particles. Some of the underground water may be taken up through plant roots as capillary water to supply them with food

from the soil, or it may form a film around each soil particle as hydroscopic water or water which is unavailable to plants.

Soil is the greatest reservoir or storage place we have for our fresh water supply. Snow packed in the mountains is next, followed by natural lakes and man-made lakes and ponds.

Water in ponds, lakes, and streams contain bacteria, plants, and animals, just as the land of the mountains and valleys has many different forms of life. The difference in the life present on land and the life in water is that plants and animals whose home is in water, live in a medium with very little dissolved oxygen. Air is a much lighter medium than water so land animals must support themselves with legs or develop the ability to fly in order to move about. Water is such a heavy medium that many plants and animals depend on it for buoyance and movement.

More water is used by agriculture than in any other industry. Much of this is used for irrigation, but natural rainfall provides water for many of our crop plants. Some of the water that plants use is lost through the leaves by a process called transpiration (evaporation from leaves). Transpiration in plants is like perspiration in people. Plants lose huge amounts of water by transpiration. Corn could lose up to 1296 tons of water per acre by transpiration in one year.

Draw a picture or diagram of the water cycle, showing evaporation, transpiration, run-off, ground water and precipitation.

Field Study Recordings

1. Study of a Stream Sample. Find an area along the stream in your field study area from which you can easily take samples of water.

   a. Instructions for collecting and recording water information.

      1. Determine the location of the stream sample in your area and its watershed. Do this by comparing the items in your streambed with the characteristics of a typical streambed in the chart below.

Typical Stream

Item	Headwaters of a Stream	Mid-region of Stream	Lower Valley of Stream
Slope of Streambed	Steep, fast flowing	Gentle	Almost flat
Rocks in streambed	Large, boulders	Smaller rocks	Silt, Sand
Temperature of water	Very cold	Moderate	Warm
Amount of useable oxygen for fish	A lot of oxygen	Enough oxygen for animals	Oxygen is Variable
Insects found	Mayfly, Stonefly, Hellgrammite	Caddis fly Mayfly Stonefly	Beetles,worms, bugs,skaters, midge,larvae

      2. Determine and record the water temperature and air temperature above the water.

         a. Take water temperature with the bulb of the thermometer under the water.

         b. Take the air temperature 1-foot above the surface of the water.

         c. Take and record water and air temperature 3 different times during the day.

      3. Determine and record the acidity or alkalinity of the water. This is called the pH of the water.

      4. Determine and record the amount of useable oxygen in the water. Follow the instructions on the oxygen testing kit provided for you. The amount of available oxygen is called dissolved oxygen and is written as so many parts of oxygen to every million parts of water - or ppm.

         Example: If the oxygen test showed 4, it would mean that there are 4 gallons of oxygen in one million gallons of water, or 4 ppm.

b. Collecting the data about the water sample following the instructions in a, collect and record the following information.

1. Location of area of the stream in its watershed. (Circle one)

Headwaters Mid-region Lower Valley

2. Information about the water

(1) Location of water sample (Edge or middle of stream	Times Taken	(2) Temperature Water Air	(3) pH	(4) Useable Oxygen (ppm)
	AM			
Note: Take 3 samples	Noon			
from one location	PM			

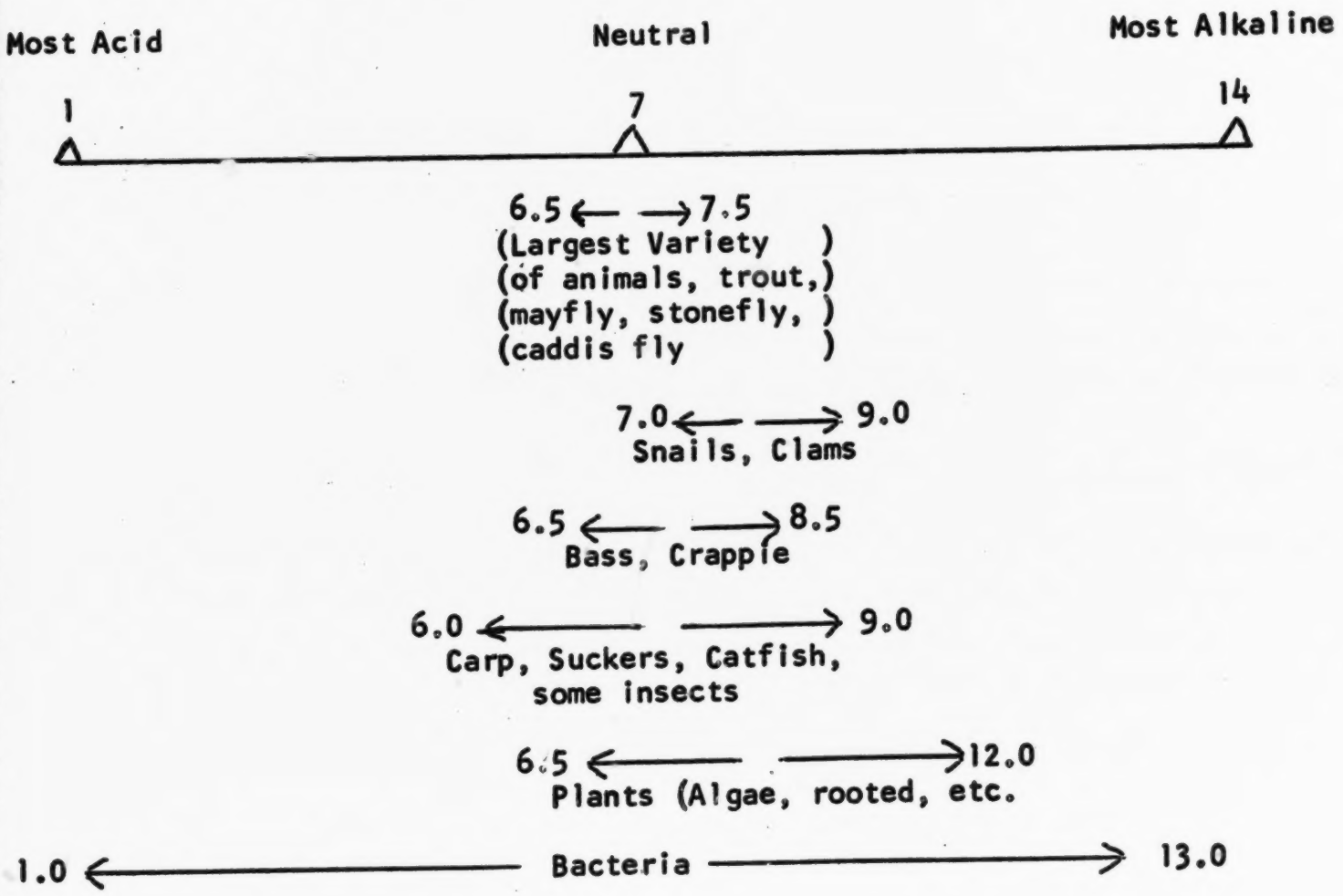
c. The following information will help you interpret the data collected from your stream sample.

1. Effect of temperature on water life. Animals that live in the water have adapted to certain water temperature ranges. Below are examples of water animals you will find within these temperature ranges.

Temperature	Life Found
Greater than 75° F	Very little animal life - much plant life
65° to 75°	Much plant life Catfish, carp, bass, crappie, crawfish
40° to 65°	Trout, Salmon, Crawfish - sparse plant life
Below 40°	A few trout, very little plant life

2. Effect of pH on water life. Animals that live in the water cannot stand too much acid or alkali in the water. A few animals have adapted to acid or alkali conditions. A swamp is usually acid. A pond would probably be alkali in summer, during plant growth, and slightly acid in fallduring plant decomposition.

pH RANGES THAT SUPPORT AQUATIC ANIMAL AND PLANT LIFE



3. <u>Effect of useable oxygen in the water on water animals.</u>
   All life needs oxygen to live. Pollution reduces the amount of oxygen in the water. Water plants also use oxygen in the water.

Still water with large amounts of plant growth will fluctuate the most in amounts of dissolved oxygen during a 24 hour period.

During daylight all plants use carbon dioxide (CO_2) and give off oxygen (O) in the photosynthetic process. At night the reverse is true, since there is no light the process is stopped and the plant uses O and gives off CO_2. If a body of water has large amounts of plants, the available O in the water will be used at night by the plants and replaced by the CO_2 given off by the plants.

Most species of animal life in the water can survive when the dissolved oxygen is 4 ppm or above. A few forms of life such as catfish and carp can survive down to 2 or 3 ppm. Below that animal life disappears.

b. Conclusions about the water sample

1. Compare the data you collected with the information on page 43 to answer these questions.

Did the water temperature fluctuate more than the air temperature?_____ Why?_____

_____

Do water animals need as many seasonal adaptations as land animals?_____

What animal life would you expect to find in this stream?

_____

_____

2. Study of Aquatic Animals. Collect and record the aquatic animals from a fast flowing (riffle) and a slow moving (pool) section of your stream.

a. Riffle examination.

Examine the complete surface of the rocks for animal life present. Place a collection screen or tea strainer in the riffle and shake the rocks and gravel above so the debris will collect in the screen. Now, hold it up so the water will drain out and the animals will remain in the screen.

b. Pool examination.

Examine the muck, leaves, and other debris in the bottom of the pool for animal life. Use the aquatic insect keys to help identify animals collected.

RIFFLE		POOL	
Kind	No.	Kind	No.

Is this the type of aquatic life you expected to find?

_____

What fish would you expect to find in this section of the stream?

_____

Is the water in the stream pure enough to drink?_____

How can you tell?_____

_____

3. Study of Aquatic Plants. Collect and record aquatic or water loving plants in or near your stream. Summarize the information on plants found in the following chart.

Name or Describe	KIND			Amt. of Flowering or Fruit	Amt. of use by Animals
	Submerged	Floating	In Muck or Wet Soil		

4. Determination of Streamflow.

a. Instructions for collecting and recording streamflow measurements.

1. Measure and mark with stakes a 100-foot distance along a straight section of your stream.

2. Find how fast the stream is flowing as follows: Throw a stick (2 or 3 inches long) in the water above the upstream marker. Record the number of seconds it takes to float between the markers. Record

No. of seconds to float between stakes _____seconds.

Now divide the 100-foot distance by the total seconds it took the stick to float between the stakes. This

will tell you how many feet the stick floated each second.

100 ft. (distance) -- $\frac{\text{100 ft.}}{\text{(total seconds)}}$ = $\frac{\text{(number of feet stick floated each second)}}{}$ ft. per sec.

3. Find the average width of the section of the stream. Measure the width of the stream at 3 places within the 100-foot area. Record the measurements below. Divide the total by 3 to get the average width of the stream.

First measurement _____ feet

Second measurement _____ feet

Third measurement _____ feet

Total _____ feet ÷ 3 = $\frac{\text{ft.}}{\text{(average width)}}$

4. Find the average depth of the section of the stream. Wade across the stream in a straight line. Measure the depth of the stream in 3 places along the straight line. Record measurements below. Divide the total by 3 to get the average depth of the stream.

First measurement _____ feet

Second measurement _____ feet

Third measurement _____ feet

Total _____ feet ÷ 3 = $\frac{\text{ft.}}{\text{(average depth)}}$

5. Find the cubic feet of water per second. Multiply the average width, average depth and the number of feet the stick floated each second. This will tell you the number of cubic feet of water flowing in the stream every second.

$\frac{\text{(Average width)}}{}$ X $\frac{\text{(Average depth)}}{}$ X $\frac{\text{(number of feet per second)}}{}$ = $\frac{\text{(cubic ft. of water flowing per second)}}{}$

Note: A cubic foot of water is the water in a container 1-foot wide, 1-foot high, and 1-foot long.

b. Use this table of water measurements to answer the questions below.

TABLE OF WATER MEASUREMENTS

A Water Flow of 1 Cubic Foot per Second	= 448.83 Gallons per Minute
One Cubic Foot of Water	= 7.48 gallons
One Cubic Foot of Water	= 62.4 pounds

How many gallons of water flow is in this stream every second?

(Stream flow in cu.ft. per sec.) _____ X (gallons in 1 cu. ft. of water) 7.48 = (gallons of water per second) _____

How many gallons of water flows in the stream every minute?

(Gallons per second) _____ X (Sec. in minute) 60 = (Gallons of water per minute) _____

Each person uses about 150 gallons of water a day. What is the total number of people who could live from the water in this stream?

(Gallons of water per min.) _____ X (No. minutes in a day) _____ = (Total Gallons water per day) _____ -- (Amount of water one person uses per day) _____ = (Total no. people who could live from water in this stream) _____

5. How does water affect:

Soil_____

_____

_____

_____

_____

_____

_____

Plants

Animal Life

Man

SUGGESTED INDIVIDUAL PROJECTS

1. Observe how vegetation may affect the rate at which water moves in the soil. How does vegetation affect the amount of run-off and soil movement, (erosion). Record observations.

2. Follow along a small stream to its source and see where it originates. Record observations.

3. Observe a beaver dam to see how beaver activities can alter the water supply. Record observations.

4. Study how to improve the quality of water in a stream, lake, or pond site. Record findings.

5. Observe transpiration of plants coating alternate sides of leaves with vaseline. Record observations.

6. Measure the water flow in a fast flowing and slow flowing portion of your stream. Collect and record the temperature, stream flow, pH, dissolved oxygen, condition of streambank. Discuss similarities and differences and their effect upon the type of animal life you would expect to find.

7. Describe your thoughts about the appearance of dewdrops of water on a leaf early in the morning by composing a poem.

8. Write a story about the life-giving qualities of water.

9. Observe and record the differences between the shape and sizes of the insect larvae found in the riffle and pool portions of your stream.

10. Install a water wheel and generator. Record your procedure, purpose, and results.

11. Install a Hydraulic Ram. Record procedure, purpose of ram, and results.

12. Place a large rock or a log in edge of stream. Record findings.

13. Install a cipiletti weir or Parshell measuring flume.
    Record (a) method of installing weir or flume
    (b) amount of water measured.

14. Run a contour line or grade line with water hose. Describe procedure. Illustrate your countour line or grade line.

AQUATIC INSECTS

1. May Flies (Ephemerotera)

May flies are abundant in streams and lakes and can be found in practically all fresh water throughout the state. The nymphs are found on the undersides of rocks or other underwater objects. They have two or three tails. The wings of the adult are held in an upright position while resting.

2. Dragonfly (Odonata)

They are found in all types of fresh-water areas; ponds, lakes, streams, and swampy areas. The nymphs can be found crawling about on the bottom, on aquatic plants, or other underwater objects. They are one of the largest aquatic insects; most of them are dark brown to greenish as juveniles, change to brighter colors as adults. When resting, their four wings are held outstretched.

3. Stone Fly (Plecoptera)

Stone Flies seem to require running water in which to live. They are never found in lakes except in the inlets and outlets. When the adult is resting its wings lie lengthwise upon the back. Nymphs are found in abundance only among the rocks in streams. Stone fly nymphs have two long and stiff tails.

4. Water Boatman (Hemiptera)

Boatmen are found in nearly all waters. They swim in an erratic pattern underwater, and usually found in slow moving waters. Boatmen are normally brownish in color and equipped with leathery wings.

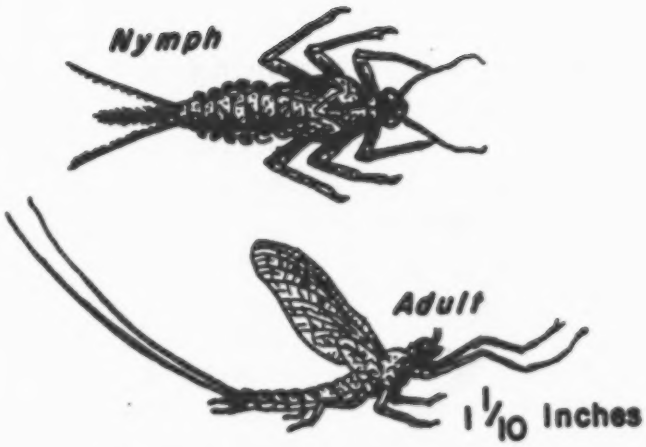
5. Water Strider (Hemiptera)

Water striders are a familiar sight on the surface of slow moving waters, ponds, and lakes. They resemble long legged spiders. Although equipped with wings, they are rarely observed in flight. Their color is usually brown to gray. Many persons call them "water skippers".

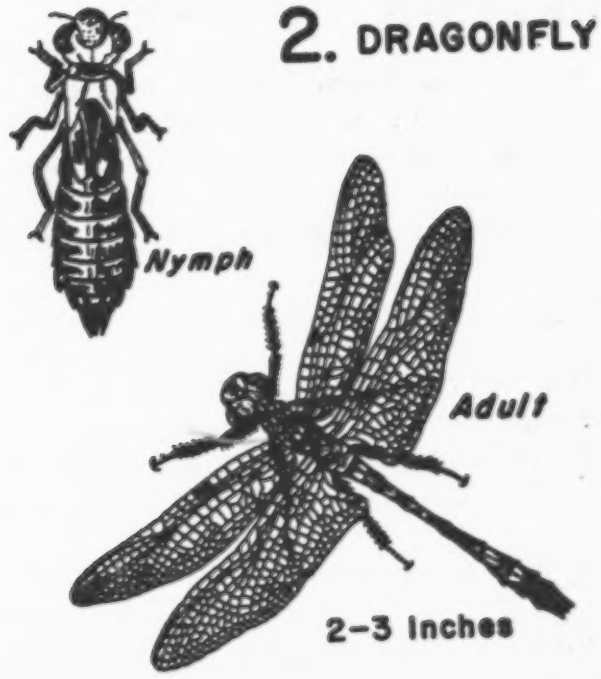
6. Caddis Fly (Trichoptera)

Caddis flies are found in nearly all lakes, streams, and ponds. During their underwater life, they live in cases made from sticks and small particles of rock. These can usually be seen moving about on the bottom. When the adults are at rest the wings are held roof-like over the body and sloping down at the sides. The adults are generally dull brown or black in color. Sometimes the larvae are called "penny winkles" by fishermen. "Periwinkle" is another common name.

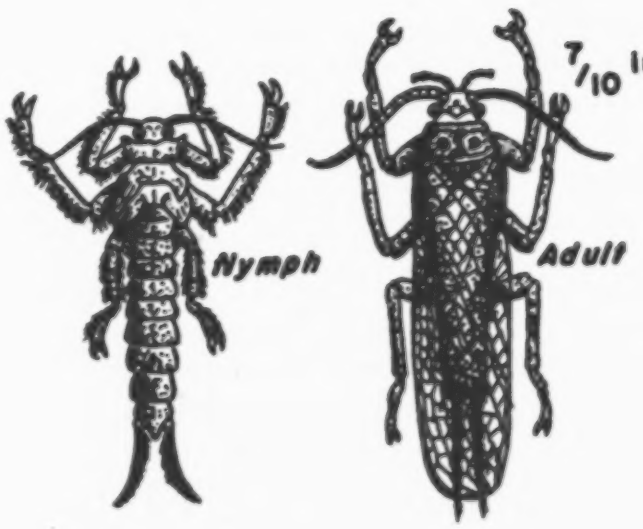
AQUATIC INSECTS



1. MAYFLY

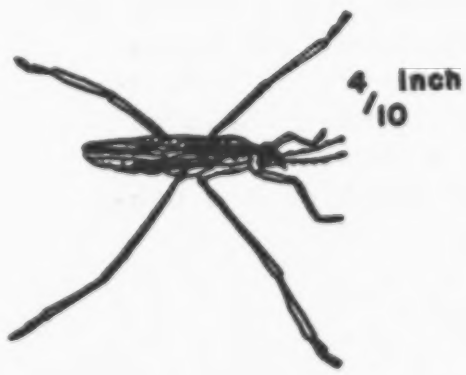


2. DRAGONFLY

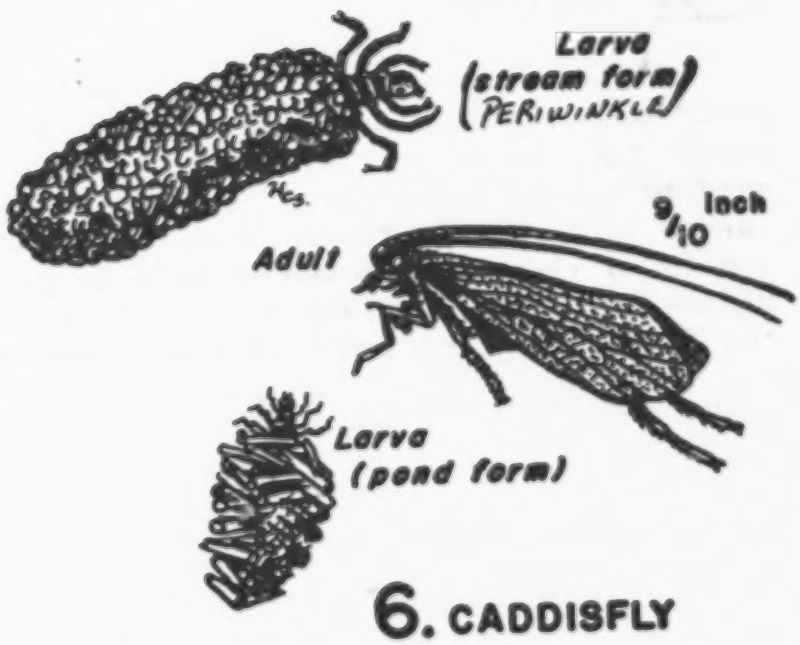


3. STONEFLY

4. WATER BOATMAN



5. WATER STRIDER



6. CADDISFLY

AQUATIC INSECTS

7. Whirligig Beetle (Coleoptera)

These are found on the surface of slow moving waters, taking advantage of the surface tension. The Whirligig beetles, true to their name, whirl or swim on the water's surface. When disturbed they dive under the water, frequently. Their bodies are dark colored, robust, and the front legs are long and slender.

8. Crane Fly (Diptera)

The larvae of the Crane fly are found in scum of shallow waters, in the damp soil along streams or lake shores, and marshy areas. The adults are never truly aquatic and may be found great distances from water. The adults look much like giant mosquitoes without a beak.

9. Mosquitoes (Diptera)

Mosquitoe larvae are usually found in stagnant slow moving water. Most people are familiar with the appearance of adults and know that they are more abundant around marshy, damp areas. The young are often called "wigglers" and can usually be found wiggling about just under the water's surface. Contrary to popular belief, not all mosquitoes bite, the males just buzz and are not equipped for biting.

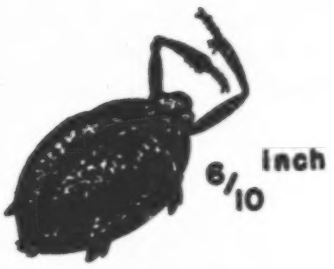
10. Black Fly (Diptera)

The larvae are found in flowing water (only) on stones, vegetation, or other objects, usually in the swiftest part of the stream. In many cases, the larvae are so numerous they appear moss-like over the surface of the attached object. Later on in life, they live in a cocoon which is customarily a boot-shaped structure. The Black fly as the name implies, are usually dark compactly built flies, with rounded black and short broad wings. The adults may be found great distances from water.

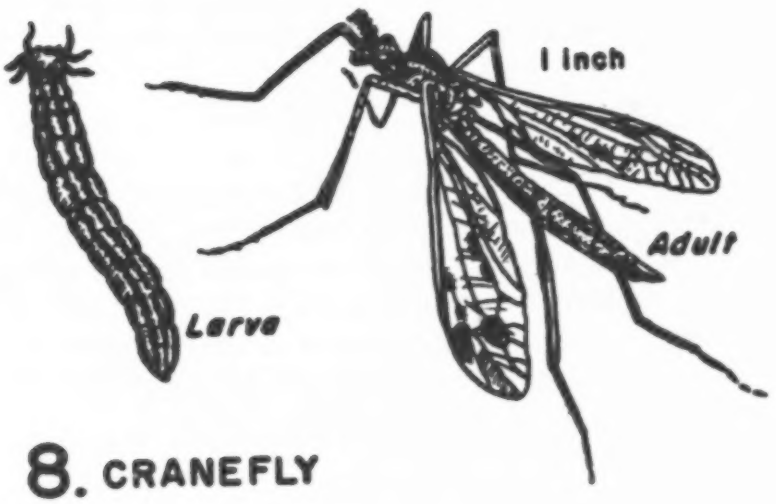
11. Midges (Diptera)

Larvae are most abundant in the shallow water areas of lakes, ponds, and streams favored by a heavy growth of aquatic plants. They prefer soft mucky bottoms, as they are a bottom-dwelling species, and need this type environment for constructing their tube-like homes. Larvae live in soft tubes, however, during later stages of life they are found living in silken cocoons or gelatinous cases. The adult Midges look much the same as mosquitoes. Their antennaes look like two feathers on the front of their head and they don't have a beak.

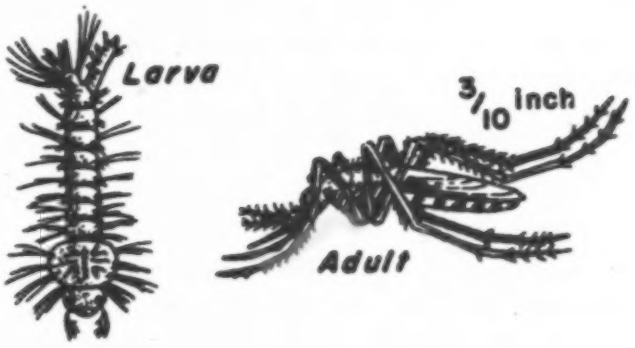
AQUATIC INSECTS



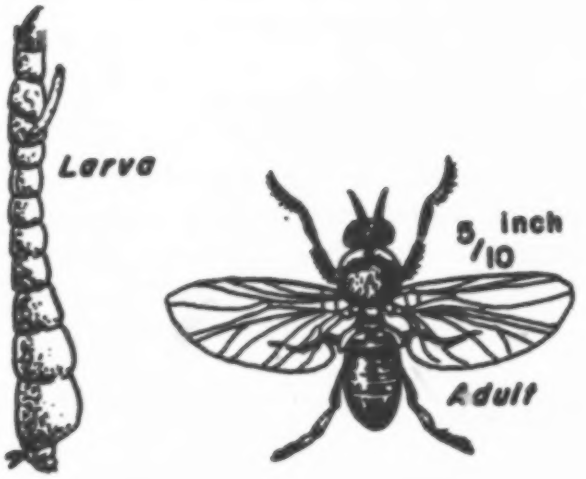
7. WHIRLIGIG BEETLE



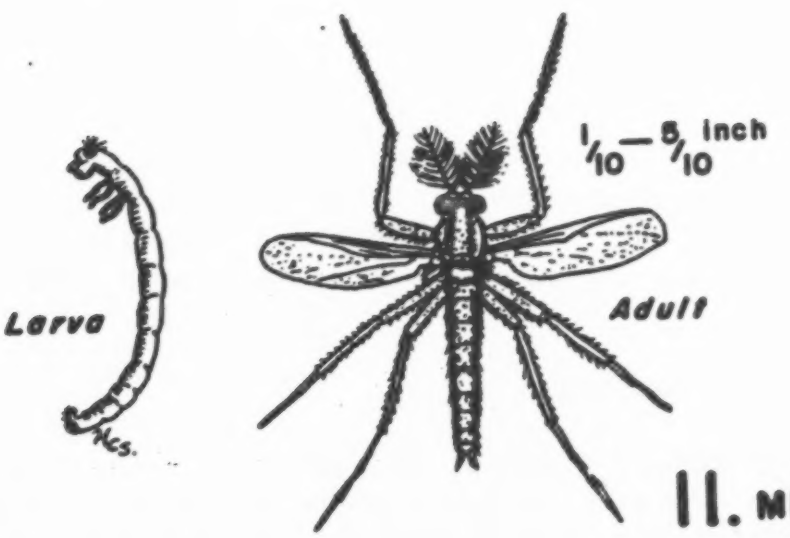
8. CRANEFLY



9. MOSQUITO



10. BLACK FLY



11. MIDGE

SUBSURFACE FRESH-WATER ORGANISMS

1. Planaria (Turbellaria)

Planariams are fairly common in ponds, lakes, springs, and other fresh waters among vegetation, beneath stones, or crawling over the bottom. These free-living flatworms are usually arrow-shaped and vary in color from white to black depending on species and environment. Small planaria look much the same as the adult differing only in size.

2. Bryozoan Colony (Broyozoa)

Fresh-water Bryozoa are very common in lakes, ponds, and rivers. They are community dwellers, living in jelly type substance which is formed on sticks as a gelatinous ball or a mossy mat over the surface of underwater objects. There is a wide range in color, some colonies are brownish and still others have a greenish tinge. Colonies are made up of thousands of these tiny animals.

3. Leech (Hirudinea)

Leeches make homes in lakes, ponds, or other fresh-water areas. They can be seen moving about underwater by their well-known "Measuring Worm" type of travel, or swimming freely. Leeches are predatory or parasitic sigmented worms with sucking discs which are used in attachment, movement, and feeding. They are usually dark brown to black in coloration.

4. Daphnia (Cladocera)

Daphnia are found in all sorts of fresh waters. The shallow, weedy backwaters of a lake whose water level is fairly permanent harbors greater numbers than any other kind of locality. These little crustaceans are virtually transparent, and are best recognized by their two-branched antennae, robust bodies, and sharp-tail spine.

5. Cyclops (Copepoda)

These little fresh-water crustaceans are very familiar in all slow moving waters, especially shallow ponds. Their bodies, like the Daphnia, are very transparent and are characterized by the forked antenna and the branched tail. The female usually has two groups of eggs attached to her body just ahead of the tail.

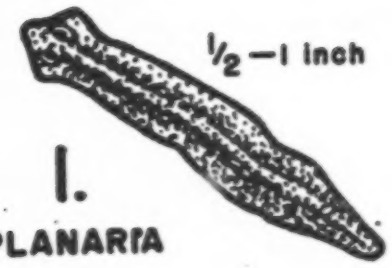
6. Fairy Shrimps (Anostraca)

For the most part, fairy shrimps live in temporary pools and ponds of fresh water. They are frequently seen underwater, rowing themselves about on their backs, by means of numerous, similar, flattened appendages. These appendages are always faced toward the source of light.

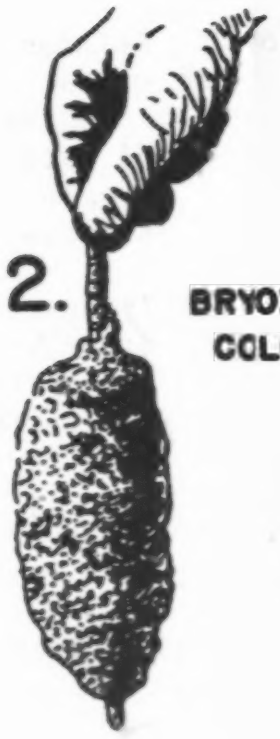
7. Fresh-Water Shrimp (Malacostraca)

These are found in lakes, streams, and ponds in eastern and western Oregon. Shrimp are usually found among the aquatic plants, rocks, and algae. Usually they are nearly transparent and look something like a "sow bug."

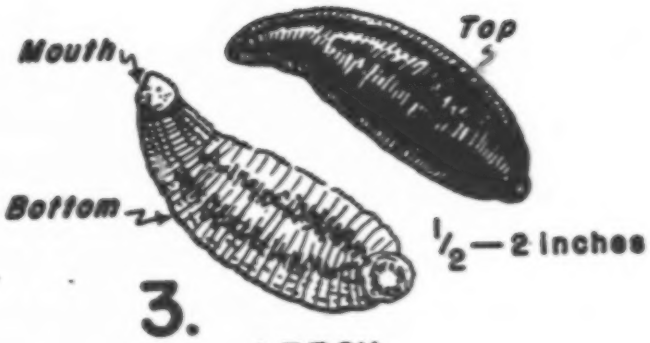
SUB-SURFACE
FRESH WATER ORGANISMS



1.
PLANARIA



2. BRYOZOAN COLONY



3.
LEECH

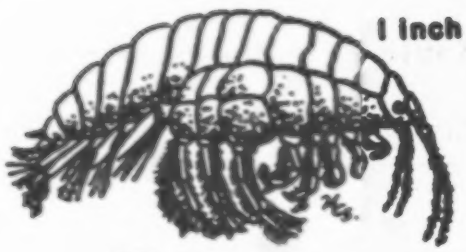
5.
CYCLOPS

DAPHNIA

4.

FAIRY SHRIMP 1 inch

6.



7. FRESH WATER SHRIMP

GLOSSARY
A List of Water Words

Conservation	Wise use (Wise use of soil, wise use of water, wise use of forests and wise use of animal life.)
Distribution	Relates to dividing and delivering of water to different users. It may be between farmers; between farmers and industry; cities and industry, etc. It is a problem of water which sometimes develops when demands exceed supply in one part of a region, although there may be a surplus in other areas.
Dissolved Oxygen	The useable oxygen dissolved in a stream, lake, ocean, or other body of water. It is essential to fish and aquatic life. There must be at least four parts of useable oxygen for every one million parts of water for most aquatic life to live.
Evaporation	The turning of water into vapor. Water changing from liquid to gas.
Water Pollution	Caused by dumping wastes into our water. These wastes may cause water to be unuseable.
Reservoir	A place where water is collected and stored for use, usually related to a man-made structure such as a pond or lake behind a dam.
Run-off	The water which runs off the earth's surface through streams.
Sediment	Any material carried in suspension in water which will settle out as the velocity of the water lessens.
Toxic	Poisonous. In water it is usually associated with a waste which kills fish and other aquatic life.
Transpiration	The process by which plants release water into the air from their leaves and other surfaces. This loss is by evaporation.
Wastes	Domestic sewage, waters from industrial processes, return irrigation waters, or any other waters which have been used by man and altered in the process.
Water Supply	That water which is delivered to us by the natural "water cycle."
Water Table	The height at which free water occurs in the soil profile.
Watershed	Any area of land which drains into a particular stream or other body of water.

A STUDY OF WILDLIFE

General Information

In our study of animals we have learned that some are tiny, some are of medium size, and some are large. Animals such as the protozoans, worms, crayfish, insects, spiders, clams, and starfish have no backbones. They are called invertebrates. Others such as fish, frogs, snakes, birds, and mammals have backbones and are called vertebrates.

There are many different kinds of animals in each study area. We will devote most of our attention to the wild animals that live here. Many of the smaller animals we will see in this outdoor laboratory live in tunnels or burrows underground. Some, including the birds, live mostly in hollow logs, stumps, or in shrubs and trees aboveground. Animals which eat other animals are called predators. Many of the mammals, including humans, are predators. Those which eat meat are called carnivores, those which feed only on plants are called herbivores. Some animals, such as pheasant, quail, deer, elk, trout, and salmon, are known as game animals because they provide hunting and fishing recreation.

Some animals are useful to Man, providing him with meat, leather, feathers, and furs. Others help to control destructive insects and small rodents. Mice, rats, chipmunks, and rabbits are important as food for larger mammals and birds such as the cougar, bobcat, coyote, owl, hawk, and others.

It is interesting to study the different kinds of animals which live together on a piece of land such as our study plot. We can learn how they depend upon each other. They also depend upon the soil, water, and plant life there for their existence. This will help us to understand how Man fits into the picture and how he affects all other living creatures. Let us make as many observations as possible to find out what animals live here, what they

look like, what kinds of homes they have, what foods they eat, and what values they have. All observations should be recorded.

Field Study Recordings

1. Invertebrates:

Invertebrates are lower forms of animal life which do not have a backbone. Animals in this group would include the one-celled animals known as protozoa. Also included in this group are the sponges, jellyfish, flatworms, roundworms, bryozoa, snails, slugs, clams, earthworms, leeches, crayfish, centipedes, millipedes, spiders, insects, starfish, and sea urchins.

Determine what kind of invertebrates live in the study area. Describe each and tell about its home and its food preferences.

INVERTEBRATES

SIZE AND DESCRIPTION	KIND	FOOD PREFERENCES	VALUE

2 Vertebrates

Vertebrates are the higher forms of animal life that do have backbones. These are the (1) amphibians, (2) reptiles, (3) fishes, (4) birds, (5) mammals.

Observe & record what kinds of vertebrates live in the study area. Describe each and tell about its home, its food preferences, and its value

VERTEBRATES

SIZE AND DESCRIPTION	GROUP 1,2,3,4,5	COMMON NAME	TYPE OF HOME	FOOD	VALUE

3. Questions:

What changes has Man made in the environment which may cause these animals to move to other areas? Can you suggest anything which might be done to improve the habitat?

Describe any indications or clues which you observe to show that animals live in your study area. Look for gnawings, scratchings, tracks, droppings, litter, dust baths, feathers, nests, runways, uneaten food, or other signs.

How does wildlife affect:

Soil

Water

Plants

Other Wildlife

Man

MAKING PLASTER CASTS OF ANIMAL TRACKS

The study of animal tracks is an interesting hobby. Much can be learned about animal habits by carefully examining the various tracks. To the expert woodsman and naturalist, tracks and other signs left by animals are like an open storybook which tells what has been happening in the lives of these wild creatures.

Here is how to preserve good tracks in mud or clay:

1. Clean track of loose particles of soil, twigs, leaves or other litter.

2. Spray track with shellac or plastic from pressurized can if available.

3. Form 2-inch wide strip of cardboard or tin into a ring surrounding the track. Press firmly into ground to give support, but allow at least 1-inch to form edge of mold for plaster.

4. Mix about 2 cups of plaster of Paris in a tin can or plastic bowl, adding water slowly until it is about as thick as heavy cream. Pour carefully into mold until plaster is about to top. Allow plaster to harden at least 15 minutes before lifting out of track. If soil is damp, hardening may take longer.

5. When cast is hardened, lift cast out, remove ring, and clean the cast by scraping with a knife blade and washing.

6. Apply thin coating of vaseline to track and surface of cast. Place on flat surface and surround casting with a 2-inch strip of cardboard or tin as before.

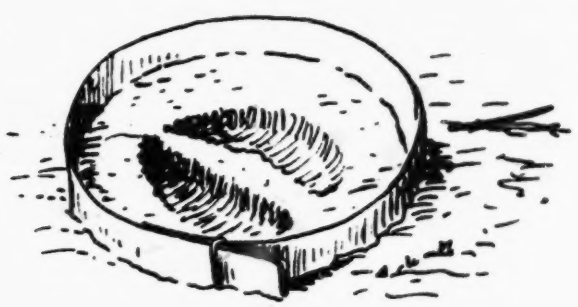
7. Mix plaster of Paris and pour into mold, making certain that top surface of casting is smooth and level with the mold. If you plan to use the casting as a wall plaque, place a loop of wire in back of casting while plaster is still soft. Allow 2 hours for plaster to harden.

8. Carefully remove mold when plaster is dry. Separate the two layers and wipe excess vaseline from face of cast and track. Scrape any rough places with knife blade, or use fine sandpaper to smooth. Wash in running water.

9. When cast is thoroughly dry, paint inside of track with India ink or black poster paint. Label with name of track. A coat of clear shellac or clear plastic may be applied to protect and preserve the casting.

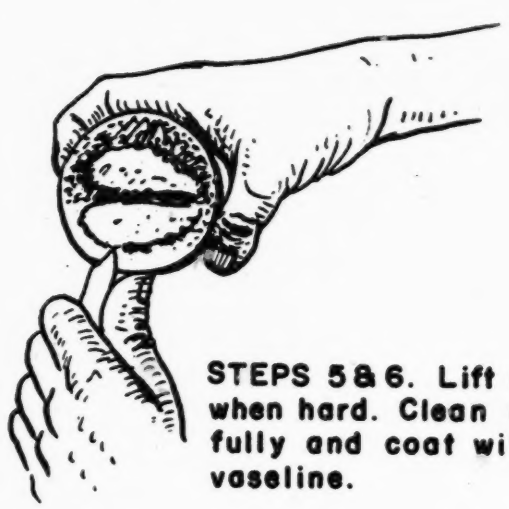
CASTING ANIMAL TRACKS

STEPS 1&2. Clean track and spray with shellac or plastic.



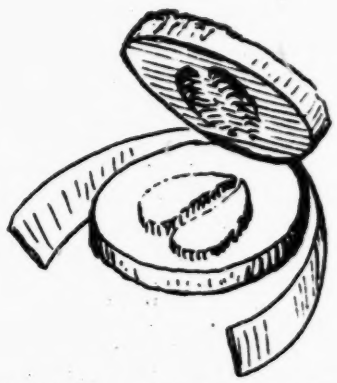
STEP 3. Encircle track with band of cardboard pressed into soil.

STEP 4. Pour plaster of Paris mixture over track.



STEPS 5&6. Lift cast when hard. Clean carefully and coat with vaseline.

STEP 7. Surround casting with wide strip and pour plaster level with mold.



STEP 8. Separate the two layers of casting. Clean vaseline from track and smooth with knife blade.

STEP 9. When caste is dry paint inside of track with black India ink.

GLOSSARY OF COMMON WILDLIFE TERMS

Amphibian - Means "living in two places." These animals hatch from eggs which have been deposited in ponds or streams. They live in the water like fish when they are young. Gradually they grow lungs and legs, breathe air, and live on land.

Anadromous Fish - Those fish which spend the greater share of their lives in salt water but migrate into fresh-water streams for reproduction.

Aquatic - Living or growing in water such as a fresh-water environment.

Browse - The shrub plants which are food for wild or domestic animals.

Carnivores - Animals that eat meat.

Carrying Capacity - The maximum number of wild game which a particular range is capable of carrying.

Environment - All those factors which make up the surroundings of any living thing.

Forage - The grasses and plants which are food for wild or domestic animals.

Forage Production - The amount of food produced annually on the range and available for animal consumption.

Furbearing - Any animal (usually mammal) sought mainly for its fur.

Game Animal - Commonly refers to those animals which are hunted for recreation and are protected by specified closed seasons or bag limits. Game fish & game birds are included.

Habitat - The total environment which provides food, water, and shelter for wildlife.

Herbivores - Animals which feed only on plants.

Hibernate - To spend the winter months in an inactive condition

Insect - A small invertebrate animal characterized in adult stage by having a division of the body into head, thorax, and abdomen; three pairs of legs; and, usually, two pairs of wings.

Lake Rehabilitation - Treatment of a lake with chemical to destroy all fish life in preparation for restocking with desirable game fish species only.

Lake Survey - A study of the lake, including sounding and mapping, to learn what physical conditions exist and what aquatic life is present.

Limiting Factor - The factor which outweighs all others in limiting productivity.

Migration - Seasonal movement of animals.

Population Inventory - A measure of the current number of a species of game animal or bird. Since it is impossible to count total populations, animals are observed per mile of travel on sample routes, and a population trend index is established.

Predator - Any animal which preys on other animals.

Protozoa - Tiny, one-celled animals.

Range - The land upon which big game animals live. (Domestic animals may also live upon such land.) i.e. winter range, summer range.

Reptiles - Like fish, are cold-blooded and their bodies are usually covered with protective scales or scale-like shells. They lay eggs and are air-breathers all their lives.

Rotary Fish Screen - A mechanical device designed to prevent passage of fish from streams into irrigation ditches.

Spider - Any of a number of small, eight-legged animals having a body composed of two divisions.